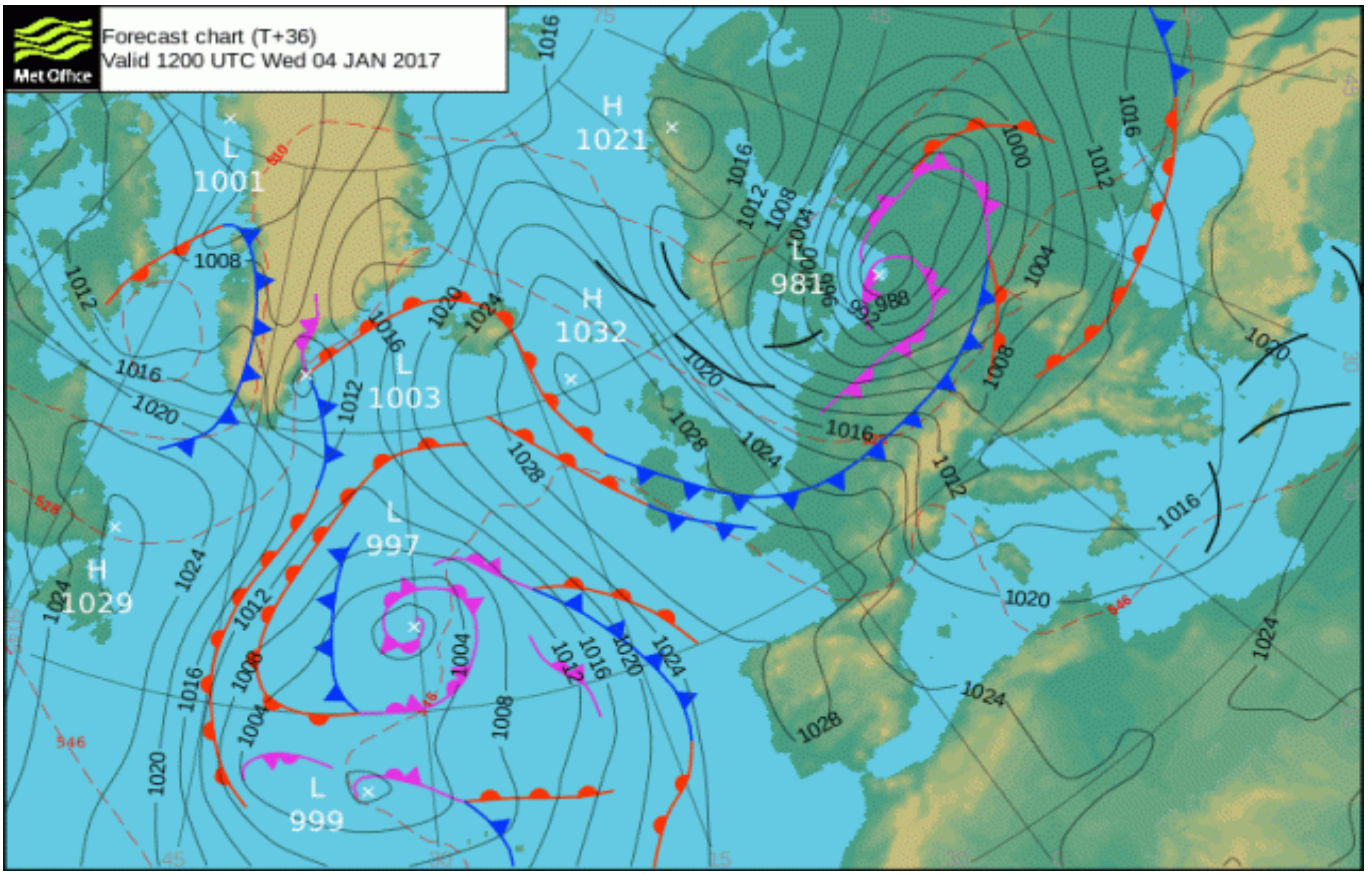
Cold weather in Europe and the US

Description

Our meteorologists will be keeping a close eye on the weather in eastern Europe and the USA this week. With high pressure dictating the weather over western Europe, cold air and associated weather systems are being funnelled southwards across eastern Europe, bringing below average temperatures and snowy conditions. Meanwhile, a plunge of cold air will deliver below average temperatures to many parts of the USA later this week.



Pressure chart for midday on Wednesday showing a deep low pressure system moving across eastern Eu

Germany, Denmark and Poland

A deep area of low pressure associated with the fronts moving through eastern Europe will bring a spell of very windy weather across northern Germany, northern Poland and Denmark later today (Tuesday) and through Wednesday. Northwesterly winds will strengthen to severe gale or storm force, particularly near the coast and over sea areas leading to a risk of coastal flooding. Wintry showers may bring disruption to transport with power supplies and communications also possibly affected by the severe weather.

Central, Northeastern and Eastern Europe

During Wednesday an active cold front will sink southwards, bringing snow to central and eastern Europe with 10-20cm possible in some parts. This will bring welcome snow cover to the ski resorts in the northern and eastern Alps, which so far this winter have received little snow, but the southern parts of the Alps will probably miss much of this snowfall.

The air behind the cold front will be much colder, enveloping much of central and eastern Europe from Thursday, leading to temperatures around 10-15 degrees below the average for the time of year in the east in places like Salzburg, Austria, Athens, Greece and Minsk, Belarus. This could lead to record-breaking minimum temperatures in some locations, however, these should recover towards the weekend. Across northern parts of Finland and Sweden, temperatures could fall as low as -40°C, with daytime maximum temperatures perhaps 15-20°C below normal.

> Heading to the Continent? ?Strong winds for Germany on Tuesday & Wednesday, whilst cold air creeps into central & eastern #Europe by Friday pic.twitter.com/fs7YgXCNJv
>
> — Met Office (@metoffice) January 2, 2017

Western and southern Turkey, northern and eastern Greece

Later in the week, the area of low pressure will have moved southwards across Europe to affect Turkey and Greece. Although the winds will not be as strong, there is the potential for some very wet weather with intense thunderstorms and the risk of flash flooding on Thursday and Friday with further unsettled weather forecast for the weekend. In western and southern parts of Turkey and northern Greece 100-150mm of rain is possible each day with snow likely over high ground, leading to further transport disruption.

Northwest, central and eastern US and southern Canada

On the other side of the Atlantic, another push of cold air is expected to move south and eastwards across the US, affecting central parts by Wednesday and reaching the east by Thursday. The cold air will lower temperatures to around 10 degrees below average, with daytime values struggling to reach 0°C and these conditions expected to last until the weekend.

Date Created
January 2017

Met Office helps Save the Children in their fight to save lives

Description

This autumn Save the Children rescued over 2600 refugees attempting to cross the Mediterranean as they fled persecution, war and hunger looking for a better life.

As with any maritime operation the impact of the weather is a significant component and Save the Children turned to the Met Office and our Aberdeen-based marine specialists for daily, route-specific forecasts as well as 5-day forecasts. This information helped support the daily search and rescue operations as well as longer term planning for the charity.

Forecasts for both good and poor weather were equally important. Poor weather not only reduced the flow of migrants and refugees but also allowed the charity's ship to return to port to refuel and re-stock before rejoining the international search and rescue mission when the weather improved.

Refugees and migrants are brought on board the Vos Hestia after being rescued at sea. Picture courtesy of Save the Children.

One of the team leaders on board the rescue vessel, Roger Alonso, said; "Met Office forecasts not only helped direct our rescue operations but also helped ensure the safety of the crew. The information included not only wind direction and speed but also vital data about surface swell. I am looking forward

to working with the Met Office again in the future."

It's thought that around 300,000 people have made the perilous Mediterranean crossing this year alone, many from Africa or the Middle East. Save the Children has now paused its rescue operations as poor winter weather conditions reduce the flow of migrants and refugees from the Libyan coast. Operations are expected to resume in the spring. Over the winter Save the Children will be assessing the operation to date and starting to plan for next spring.

Save the Children ready to conduct rescue operation in the Mediterranean Sea. Picture courtesy of Save the Children.

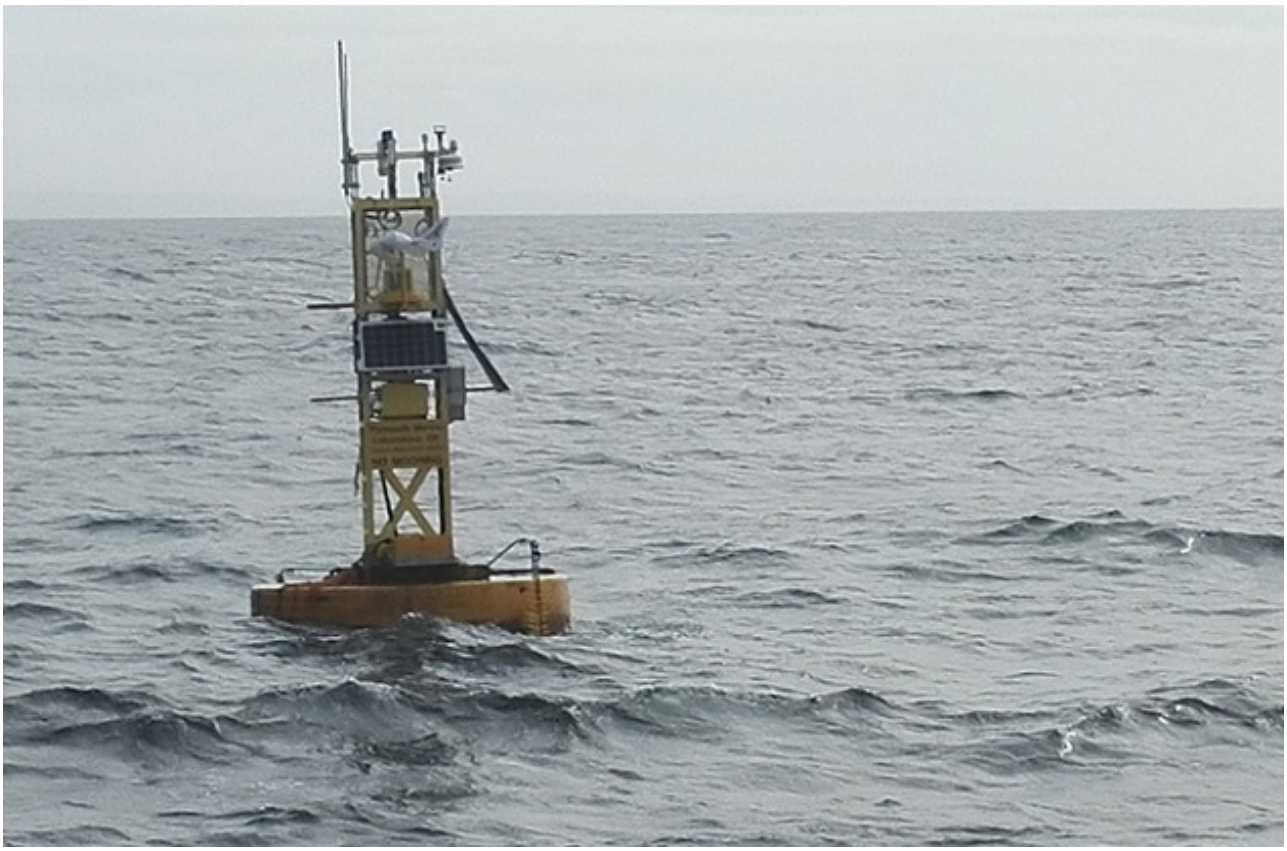
The Met Office continues to work with humanitarian agencies around the globe. In addition to the work with the Save the Children we continue to provide support to the World Food Programme with work in Syria and last winter we worked in partnership with other meteorological services to support the UNHCR (United Nations High Commission for Refugees) in their operations during the South Eastern European refugee crisis. These examples demonstrate what can be achieved when our science, business and operational teams work in partnership with humanitarian agencies to deliver vital life saving services.

Date Created
January 2017

The challenge of taking the temperature of the world's oceans

Description

Sea-surface temperature measurements are an essential component in the production of the average global temperature figures. Without data from the oceans we wouldn't see 70 per cent of the world's surface and we would get an unrepresentative picture of global change. But piecing together an accurate picture across the vast expanse of the world's oceans and decades of time and technical changes is extremely challenging.



Buoys, such as this one off the South Devon coast, are becoming increasingly important in measuring sea-surface temperature. Picture: Grahame Madge (Met Office).

When putting together global temperatures, there are two main sea-surface temperature data sets: one, produced by the Met Office Hadley Centre, known as HadSST3; and another, produced by NOAA , known as ERSSTv4. A new scientific paper in the journal ScienceAdvances has drawn attention to small differences between these data sets, and between two of the National Oceanic and Atmospheric Administration's data sets (ERSSTv4, and its earlier version ERSSTv3). The new study suggests there have been some small improvements to how the global rate of warming is represented in NOAA's latest data set, which warms slightly faster in recent years.

The difference between NOAA's latest data set and the Met Office data set is estimated to be around

0.03 °C per decade over the period 1997-2015 in the global average. It is important to note that this study focuses on the global average. Figure 1 shows the differences between the two data sets in the context of long-term global sea-surface temperature change. The level of the discrepancies discussed, though evident at the global scale, are small compared to regional variations in temperature (Figure 2), and small when compared to longer-term changes in the global average.

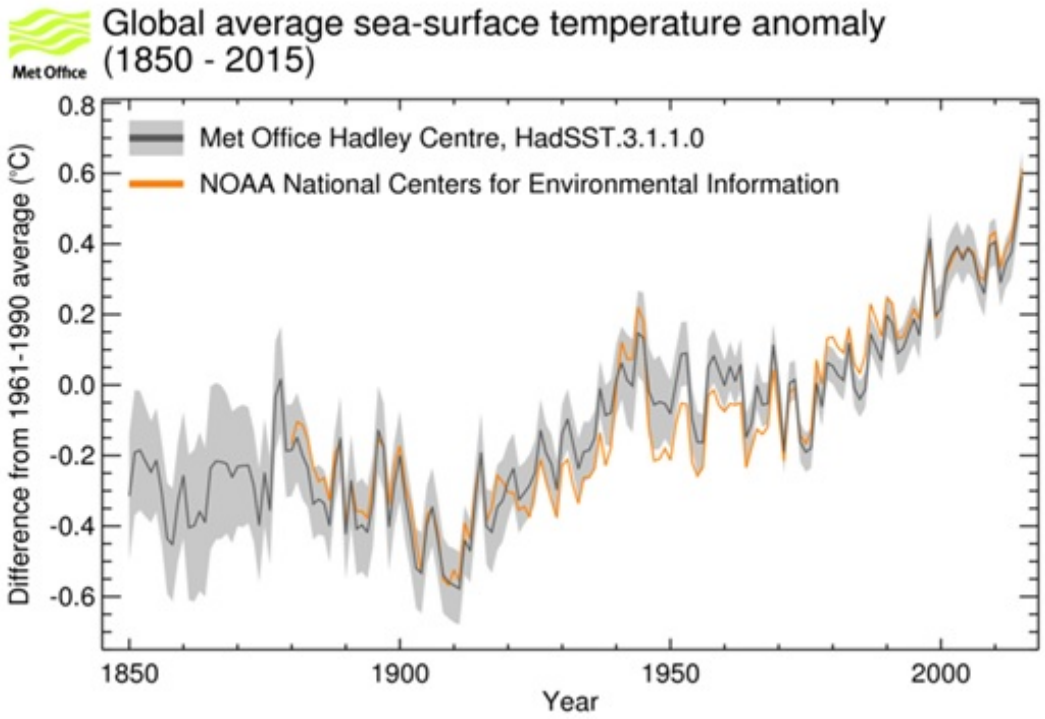


Figure 1: differences between the NOAA and Met Office Hadley Centre data sets in the context of long-term global sea-surface temperature change.

It is important to note there is variability in global temperatures such that trends, for example over 15-year time periods, slow down and speed up, as part of the longer term global warming trend seen over the last century.

John Kennedy is a scientist with the Met Office Hadley Centre who helps to collate figures for global average temperature. He explained: “The sea-surface temperature measurements used in the global data sets are made by both ships and buoys. The data that both we and NOAA use come from the International Comprehensive Ocean Atmosphere Data Set and are updated in near real-time using data sent over the global telecommunication system. Because we use the same basic data, differences between the data sets largely come from the different ways scientists deal with the changing mix of measurements over time.”

Buoys provide more consistent sea-surface temperature measurements than ships. The design of drifting buoys was standardised in the 1990s and in many studies they have been shown to make more accurate measurements, at least on average. The number of measurements from buoys has increased massively over the past 30 years, and they now form the greater part of the surface-monitoring network for sea-surface temperatures over the oceans.

Although the network of buoys is expanding, ships still provide vital data. John Kennedy added: “Ship-based measurements have been made in a variety of ways. The most frequent current methods are: engine-room measurements, where a thermometer is inserted into a water-inlet pipe in the ship’s engine room; and hull sensors, which make temperature measurements through the ship’s hull.”

It is possible to make accurate measurements in these ways but, on average, the measurements being recorded had been found to be a bit warmer than the true sea-surface temperature.

John Kennedy added: “However, it appears that since the early 2000s, the ship-based measurements have been getting progressively cooler, relative to buoy measurements. The reasons for this are still unclear but, if not accounted for, it could lead to an underestimate of changes in global sea-surface temperature.”

Scientists managing the different data sets have applied adjustments to the data to account for these kinds of changes. However, the approaches they take are quite different and give slightly different results. One key difference is that the team working on NOAA’s latest data set have applied an adjustment to the ship data which accounts for the cooling seen in the data since the early 2000s.

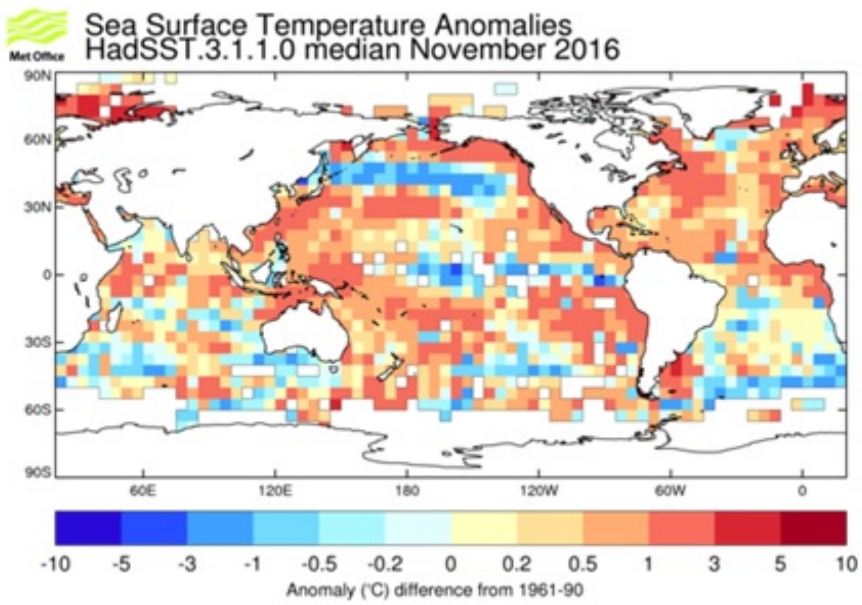


Figure 2: regional variations in sea-surface temperature recorded by the Met Office Hadley Centre HadSST3 data set for November 2016.

This new study uses a number of shorter data sets. Each of these is based on measurements made purely from a single type of instrument, avoiding dealing with a changing mix of measurements. They

look particularly at instruments, such as Argo floats – which give high-quality measurements – and satellite datasets that are somewhat independent of the surface networks. By comparing these to the different global sea-surface temperature data sets, they provide independent confirmation that the adjustments applied in NOAA's latest data set have led to a more accurate estimate of global sea-surface temperature change over the past 20 years.

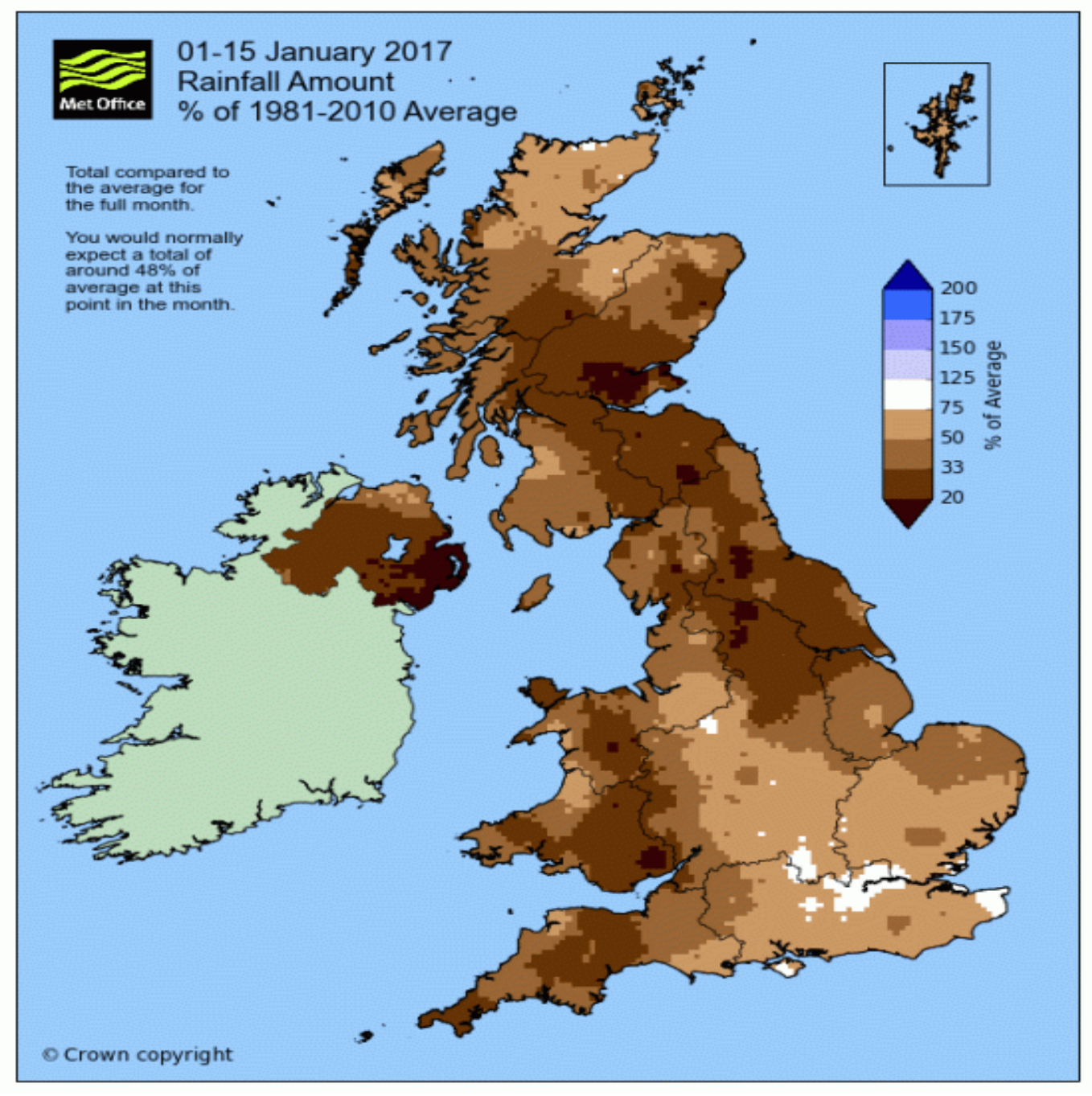
The data sets used to drive the global surface temperature record are continually evolving as scientific understanding increases. Following a Met Office-hosted international workshop in 2015 on understanding biases in sea-surface temperature records, a peer-reviewed paper making recommendations about how to understand these differences and improve all datasets has been accepted for publication. John Kennedy added: "As scientific understanding develops we continually improve our own global temperature dataset."

Date Created
January 2017

Dry start to January

Description

Provisional figures show it has been drier than average in most areas of the UK so far this month (January 1 – 15), with a few places receiving around 20% of the month's average rainfall, primarily the east of both Scotland and Northern Ireland. Armagh has received 20% of it's expected monthly rainfall, Clackmannanshire 19%, and Yorkshire 27%. We would expect to see around 50% of the average rainfall at this point in the month.



However, a few places in south-east England and the north of Scotland are already not far off the whole month average, with Middlesex having seen 81 % of the month's average rainfall and Surrey 72%.

October, November and December were all drier months recording below average rainfall.

Month	Actual rainfall	Long-term Average rainfall 2010

January 1 -15th	47.5mm (39% of average. You would normally expect a rainfall anomaly of around 48% at this early point (1st-15th) in the month).	121.7mm
December 2016	82.4mm (69% of average)	120.2mm
November 2016	107.9mm 89% of average	121.2mm
October 2016	48.9mm 38% of average	127.1mm

The current figures only take us to the 15th and there is plenty of time for the situation to change before the end of the month.

The weather for much of the first half of January has been generally settled, though temperatures have alternated between just above and just below average.

Cold air moved across most of the country at the start of the month to be replaced by much milder air around the 6th, before a further cold outbreak from the north brought significant snowfalls to many areas including the Home Counties on the 12th, with most areas becoming milder again by the 15th.

Temperatures have averaged out around normal over the first two weeks of January. Northern England and southern Scotland has so far this month seen above average sunshine amounts while the northwest has been duller with below average.

1-15 January 2017	Mean temperature		Sunshine hours			Rainfall
	Actual deg C	Anm	Actual	hours	% of average	Actual mm
UK	4.1	0.5	24.9		53	47.5
England	4.4	0.3	29.1		54	36.2
Wales	4.7	0.6	19.6		40	50.7
Scotland	3.3	0.7	19.7		55	68.2
N Ireland	4.9	0.7	22.2		50	31.3

It looks like high pressure will dominate for the rest of this week resulting in benign, cloudy conditions and that the rest of the month may see more unsettled conditions spreading south and east with outbreaks of rain at times across the country.

You can keep up to date with the weather using our forecast pages and by following us on Twitter and Facebook, as well as using our new mobile app which is available for iPhone from the App store and for Android from the Google Play store.

Please note that these provisional figures, especially for rainfall & sunshine, are subject to revision. Anomalies are expressed relative to the 1981-2010 averaging period.

Date Created
January 2017

Impacts of extreme space weather on the UK

Description

by Mark Gibbs, Met Office Head of Space Weather

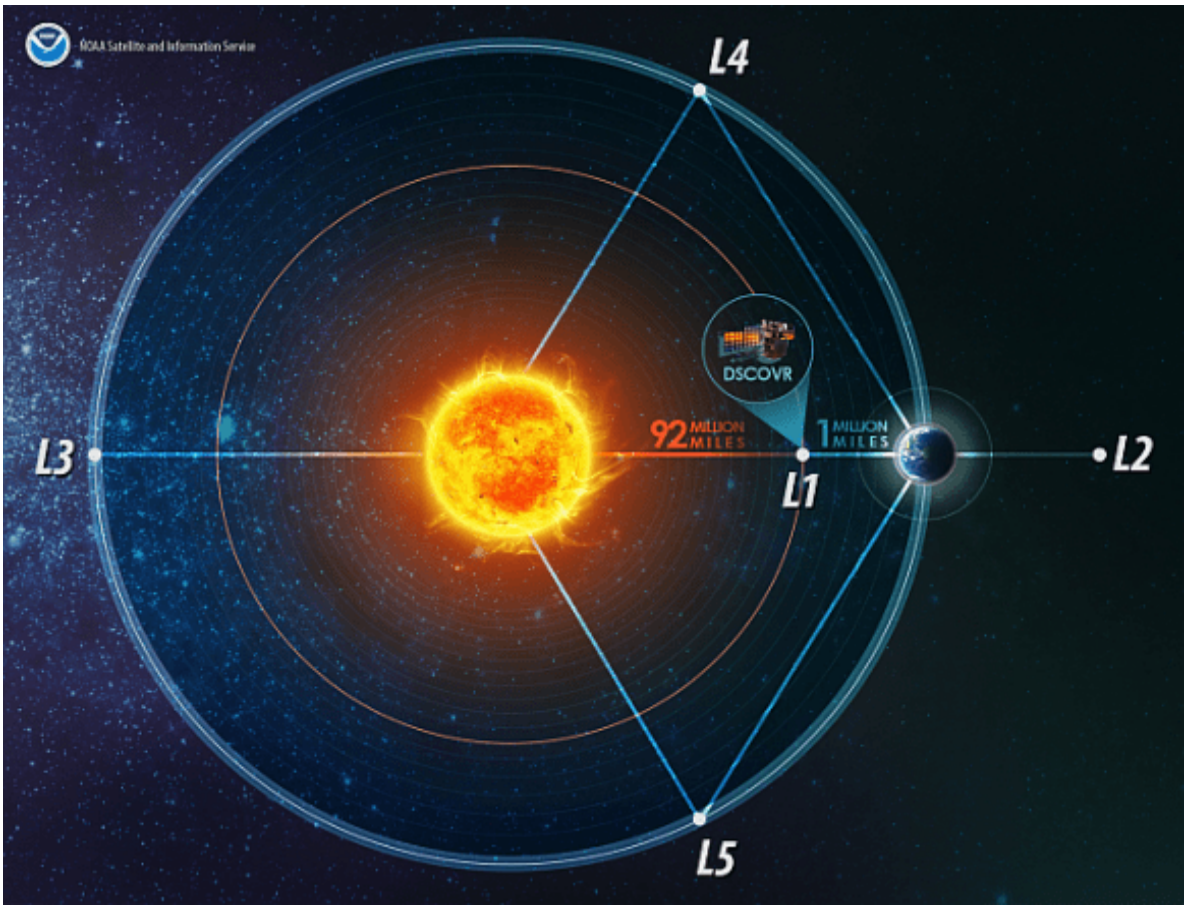
A recently published paper assessing the impact of an extreme space weather event on the US power grid suggests the total cost of an electricity blackout, both direct and indirect, could reach a staggering $40 billion a day, but that is probably very much at the upper end of estimates.

When thinking about the impacts in the UK it is important to bear in mind the UK's power grid is estimated to be at far less risk than the US grid due to its design, configuration, and management. However the potential impacts are such that space weather has been included on the Government's National Risk Register since 2011.

There is no doubt the impacts from an extreme space weather event could be significant however as our understanding of space weather improves so will our estimates of its financial impacts. Part of the UK's response to mitigating potential risks was the creation of the Met Office Space Weather Operations Centre in 2014.

Coronal mass ejections (CME) are magnetised plasma bubbles released from the Sun, which if Earth directed, create geomagnetic storms capable of interfering with satellite based navigation and communications, aviation systems and disrupting power grids. Accurate prediction of their arrival is essential when it comes to minimising the risk of impacts.

However the only permanent viewpoint of earth directed CMEsis a head- on, which is the most important. A side-view would dramatically improve estimates of the speed of CMEs, as demonstrated by the NASA Stereo mission, but there is no permanent operational spacecraft providing this side-on viewpoint.



The five Sun-Earth Lagrange points. Credit: NOAA

Although previously recognised, recent UK efforts, involving joint studies and an international workshop, have highlighted how essential a new spacecraft is and called for a mission to a gravitationally stable point in space known as Lagrange point 5 (L5).

Recognising how important this was to UK resilience the UK Space Agency increased its funding to the European Space Agency (ESA) and there are now European plans to develop and launch a new space-weather spacecraft to L5. This could dramatically improve forecasts of solar storms that affect Earth.

The UK is a global leader in the design, manufacture and operation of spacecraft and space weather instrumentation putting UK organisations in a strong position to play key roles in the mission development. It is hoped this mission will be operational through much of the 2020s working alongside the next US mission to L1 another stable point between the Earth and the Sun, already well populated with spacecraft.

What next?

A further international meeting “L5 in Tandem with L1: Future Space-Weather Missions Workshop” is being held in London in March. This will bring together space agencies, scientists, spacecraft manufacturers, instrument developers, modellers and forecasters to consolidate global efforts to protect our planet from space weather.

Date Created

January 2017

Looking hard at the accumulated evidence of climate change

Description

HRH, the Prince of Wales, who has co-written the forthcoming Ladybird Expert Series Climate Change book – wrote a guest editorial in the Mail on Sunday in which he suggested a ‘focus on looking hard at the accumulated evidence’ of climate change.

Professor Stephen Belcher is the Met Office Chief Scientist. He said: “Last week, climate scientists reported on the fact that during 2016, the world had marked yet another record-breaking year for global temperature, so the comments by HRH, the Prince of Wales on climate change are extremely timely.”

The natural variability of weather means that extreme weather events have always occured. The challenge for climate scientists is to be able to attribute extreme weather events to a changing climate.

Climate scientists around the world, including colleagues at the Met Office are thus striving to understand the links between the natural variability of extreme weather events and climate change. This is a developing science and increasing understanding will be vital to decision makers when planning policies to avert the worst effects.

Professor Peter Stott is the Acting Director of the Met Office Hadley Centre, and is a world authority on

attribution science – the study of ‘attributing’ weather events to climate change. He said: “The frequency of many weather extremes, such as heatwaves and heavy rainfall events, has been increasing worldwide. This is in line with predictions from climate models and well established understanding of how the climate responds to increasing greenhouse concentrations in the atmosphere.”

As temperatures rise the frequency of hotter temperatures increases and with more moisture in the air there is a greater chance of very intense rainfall.

“A wealth of evidence has now shown that increasing greenhouse gases from human emissions have caused the planet to warm. Global temperatures for 2015 and 2016 were over 1 degree Celsius warmer than late 19th century temperatures. The dominant contributor to the warming seen over the past century is from human activity through burning of fossil fuels.” But does that mean we can link recent extreme weather events – like Storm Desmond that brought flooding to Cumbria in December 2015 or like the heatwave over large parts of England in September 2016 – to human-induced climate change?

It can be all too easy to put the entire blame of weather-related disasters on anthropogenic climate change. Floods, droughts and heatwaves have happened many times in the past in our variable climate, but given that natural climate variability can also lead to extremes in our weather, misattribution can easily lead to bad policymaking about how to adapt to climate change.

Peter Stott added: “Now scientific research is showing that we can address the attribution of extreme events by calculating how the probability of particular types of events such as floods and heatwaves have changed as a result of human induced climate change. To do this we compare what actually happened with what might have happened in a world without climate change. Climate models are used to determine how the world could have evolved without greenhouse gas emissions and other human factors on climate.”

Such studies have shown that many heat-related events observed in recent years have been made much more likely by climate change. The chances of the record annual mean UK temperatures seen in 2014 have become about 10 ten mores likely as a result of climate change.

Peter Stott added: “But attributing extreme rainfall events such as occurred in Storm Desmond in December 2015 and which led to extensive flooding is much more difficult. This is because rainfall is much more variable than temperature and climate models can still struggle to simulate some of the fine details of how rain forms in weather systems. But as models improve new research is beginning to emerge showing that for some events at least anthropogenic climate change is playing a significant role.”

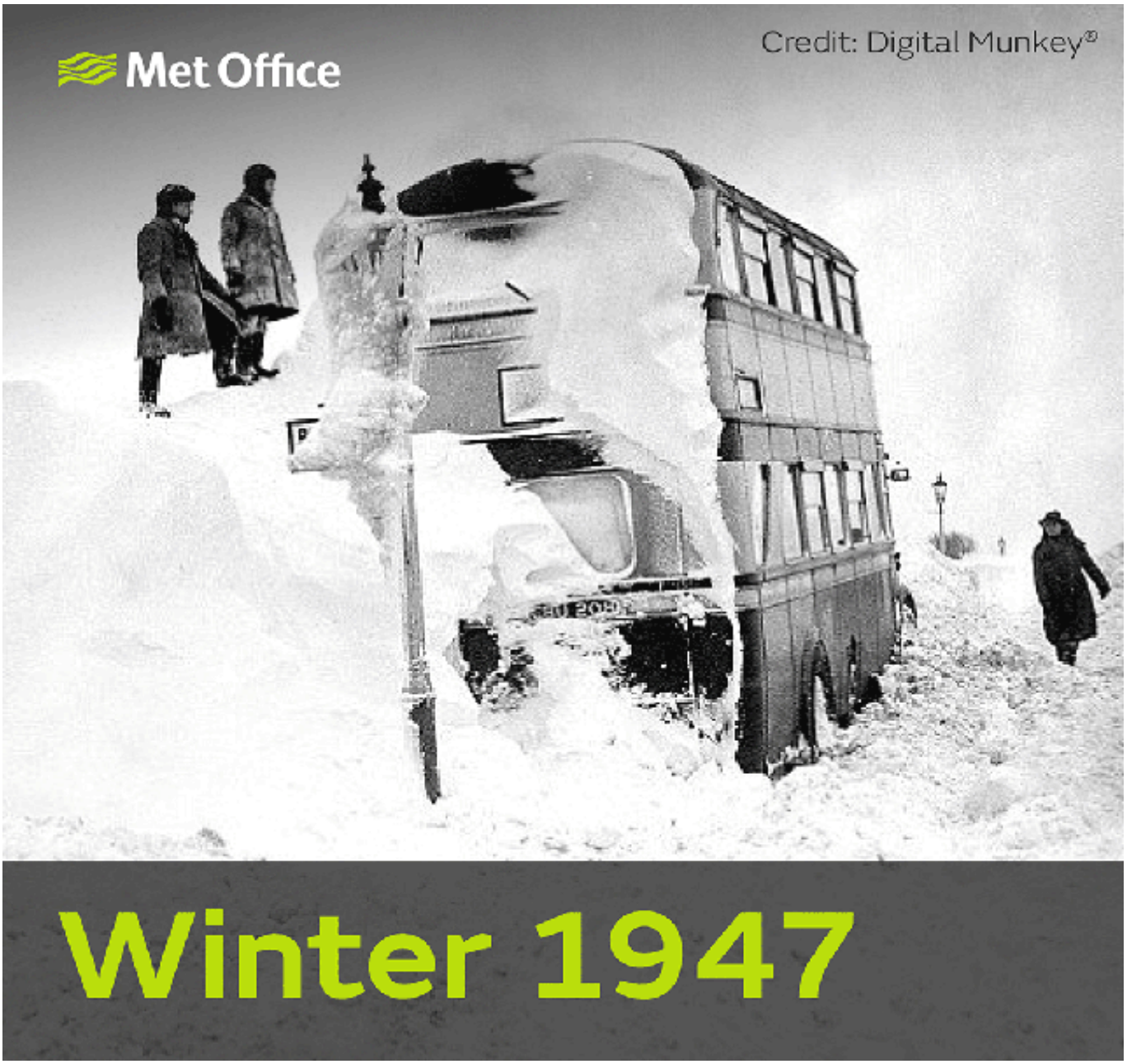
More research needs to be done before such attribution analyses become as routine as our familiar weather forecasts. But researchers at the Met Office are collaborating with international partners to develop an operational attribution system for extreme weather and climate events. Such a system would deliver regular updates putting recent extreme events into the context of climate variability and change. This would enable people to better understand how climate change has affected them and help them prepare better for the future.

Date Created
January 2017

Winter 1947 brought a freeze to post-war Britain

Description

If you’re old enough to remember 1947, then you’ll almost certainly have the winter as one of your most vivid memories of the year. For meteorologists and climatologists, the winter of 1947 was a standout year for the UK, but the statistics don’t tell the full story of the severity of the winter and the significant impact that it had on communities across the UK.

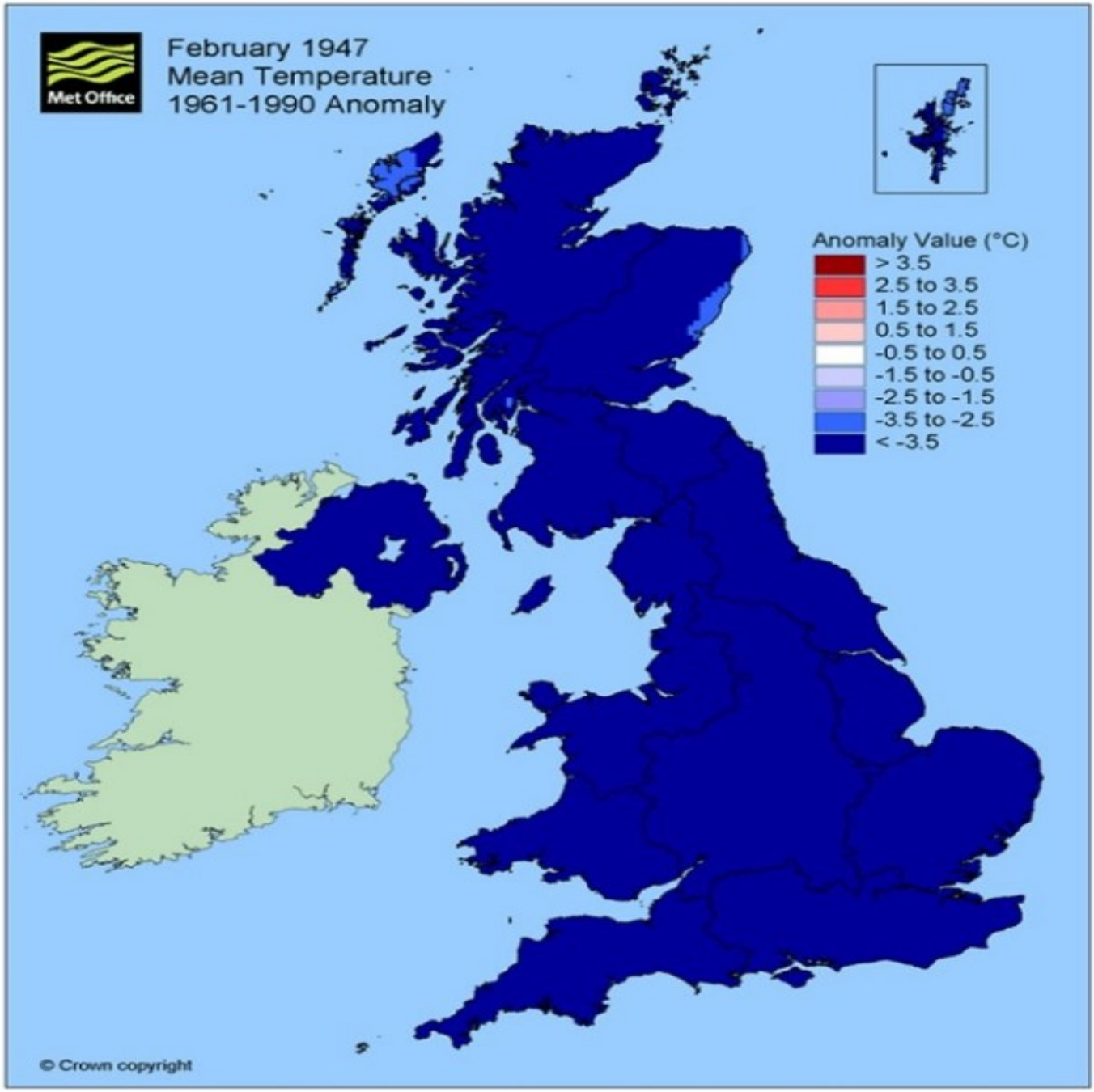


Seventy years ago, from late January until mid March, easterly winds drove a succession of snowstorms across the UK resulting in what was believed to have been the snowiest winter since the

mid-nineteenth century. Six weeks of snow, which began on January 23, led to thousands of people being cut off by snowdrifts. As the UK was recovering from the effects of the Second World War, the armed forces were called upon to clear roads and railways of snowdrifts that were up to seven metres deep in places.

According to the record, snow fell every day somewhere in the UK for a run of 55 days. Because the temperature on most days barely exceeded freezing, much of the snow settled.

Mike Kendon, who works for the Met Office's National Climate Information Centre, has co-authored several papers on the severity of British winters. He said: "It was clear that no-one expected the winter of 1947 to be severe. At the start of January the conditions were generally very mild and temperatures of up to 14 °C were recorded in places. However, all of this was to change as an area of high pressure set up a weather pattern which dominated the UK for the rest of the winter."



February 1947 was the coldest February on record in many places. At Kew Observatory the temperature didn't rise above 4.4 °C, and in Bedfordshire on the 25 February, the temperature dropped to -21 °C.

Mike Kendon added: "Meteorologically, spring begins on 1 March. But in the early part of March 1947, people's minds weren't on spring. Gales and heavy snowstorms brought blizzard conditions especially on March 4 and 5 when heavy snow fell over most of England and Wales. This led to drifts several metres deep in parts of the Pennines and the Chilterns.

"Many people regard 1963 as a record winter, and in the record going back to 1910, this winter does stand out. But 1947 broke after the middle of meteorological winter, which in one way dilutes the severity of the second half of winter."

At the end of the freeze, rising temperatures brought a rapid thaw of the deep snow which led to meltwaters pouring into rivers, causing many to burst their banks.

Of course it wasn't just people who were affected, as wildlife was also dealt a cruel blow. Naturalist and broadcaster Chris Packham, who is currently on our screens as one of the presenters of BBC Winterwatch, said: "Winter is always a challenging season for wildlife, but some winters stand out as being especially harsh, with 1947 being a particularly brutal example. Reports following the winter showed that many species suffered to an extent and some endured very harsh times indeed. Notably, small-bodied birds, such as wrens, goldcrests, pied wagtails and long-tailed tits, fared extremely badly. In fact the numbers of goldcrest – Britain's smallest bird – were hit in almost all locations. Fortunately, the populations of these birds recovered and the long-tailed tit – thanks to a combination of a run of relatively milder winters and garden-birdfeeding – is enjoying good times as it is now one of our most familiar garden birds."

Further information on severe winters is available here.

Date Created
January 2017